Comparison of Lead Species in Household Dust Wipes, Soil, and Airborne Particulate Matter in El Paso, Texas, by X-Ray Absorption Spectroscopy

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Understanding the interplay of indoor and outdoor sources of lead in an urban setting is one foundation in establishing risk for lead exposure in children in our cities. A household may be the source for lead contamination due to the deterioration of interior lead-based paint, or a sink if lead particles are tracked or blown into the home from such potential ambient sources as yard soil or urban street dust. In addressing this issue, X-Ray Absorption Spectroscopy (XAS) presents the opportunity to directly and quantitatively speciate lead at low concentrations in bulk samples. We performed XAS analyses on dust wipes from window sills or floors from 8 houses that exceeded Federal standards for lead in dust. We entered these data into a Principal Components Analysis (PCA) that also included El Paso environmental samples: lead-based paints, soils, and airborne particulate matter. A simple two-component mixing system accounted for more than 95% of the variance of this data set. Paint and lead oxide appear to be the principal components, with all the samples falling in a compositional range from pure paint to 75% paint, 25% lead oxide. Note that several different lead compounds are possible constituents of a given lead-based paint. The paints spread from one end out along perhaps a fifth of the range of the compositional axis, followed closely, but not overlapped, by the soil samples, which covered the remainder of the compositional range. Two of the dust wipes plotted within the paint range, and the remaining 6 dust wipes plotted randomly through the soil range. Samples of airborne particulate matter plotted in both the paint and soil ranges. These observations suggest that the lead on most of the dust wipes originated outside the house, probably from deteriorated exterior lead-based paint deposited in adjacent yards. This paint mixed with lead oxide present in the soil and entered the houses by the airborne route. The probable source of the oxide in the soil is former airborne deposition of automobile exhaust from leaded gasoline (lead halides quickly react to form oxide). The

dust wipes that fall within the compositional range of the paints may have originated from deterioration of interior paint. The XAS findings are consistent with our tests of several hundred houses in El Paso: most of the wipes that exceeded Federal lead standards came from houses in the oldest neighborhoods of the city, where lead paint is still present. X-Ray absorption spectroscopy experiments were conducted at the Stanford Synchrotron Radiation Laboratory on beam lines 7-3 and 10-2. Spectra were collected at the Pb L-III absorption edge in fluorescence mode using a 13-element or a 30-element Ge solid-state detector. This publication was made possible by grant numbers 1RO1-ES11367 and 1 S11 ES013339-01A1 from the National Institute of Environmental Health Sciences (NIEHS), NIH. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIEHS, NIH.

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